US009081886B2

(12) **United States Patent**
Schifman et al.

(10) **Patent No.: US 9,081,886 B2**
(45) **Date of Patent: *Jul. 14, 2015**

(54) **MEDICATION DISPENSING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 36 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/785,548**

(22) Filed: **Mar. 5, 2013**

(65) **Prior Publication Data**

US 2013/0178977 A1 Jul. 11, 2013

Related U.S. Application Data

(63) Continuation of application No. 12/036,876, filed on Feb. 25, 2008, now Pat. No. 8,412,375.

(51) **Int. Cl.**

G06F 17/00	(2006.01)
G06F 19/00	(2011.01)
G07F 11/62	(2006.01)
G07F 17/00	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 19/3462*** (2013.01); ***G07F 11/62*** (2013.01); ***G07F 17/0092*** (2013.01)

(58) **Field of Classification Search**

CPC B42F 7/12; B62B 3/16

USPC 700/231–244

See application file for complete search history.

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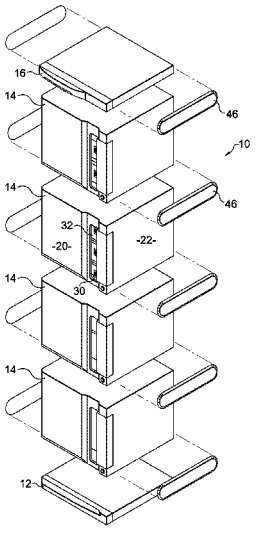
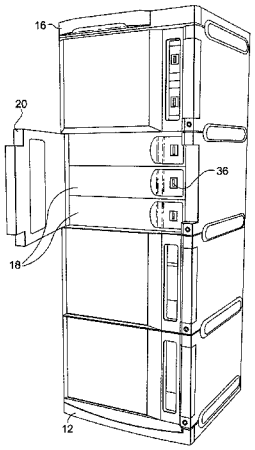
(57) **ABSTRACT**

A medication dispenser provides automation to the steps of locating and acquiring medications or supplies to be administered to a patient. The medication dispenser includes one or more modules housing one or more compartmentalized drawers. Access to each drawer is controlled by a lockable door, and each the drawer may only be slid from the module housing the drawer in response to a signal. A series of lights direct the user to the appropriate drawer and the appropriate compartment of the relevant drawer to remove the appropriate medication or supply.

18 Claims, 4 Drawing Sheets





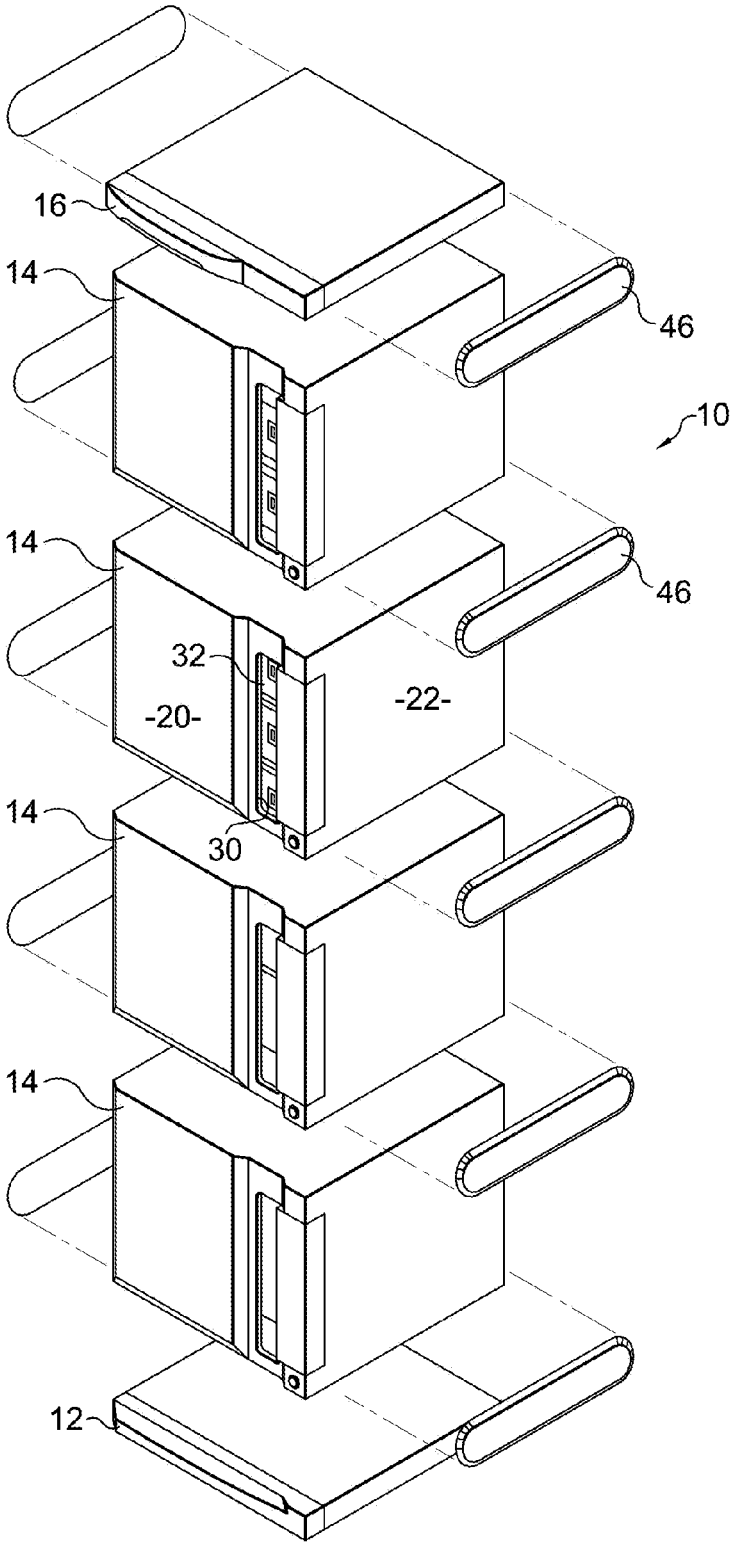


FIG. 1.

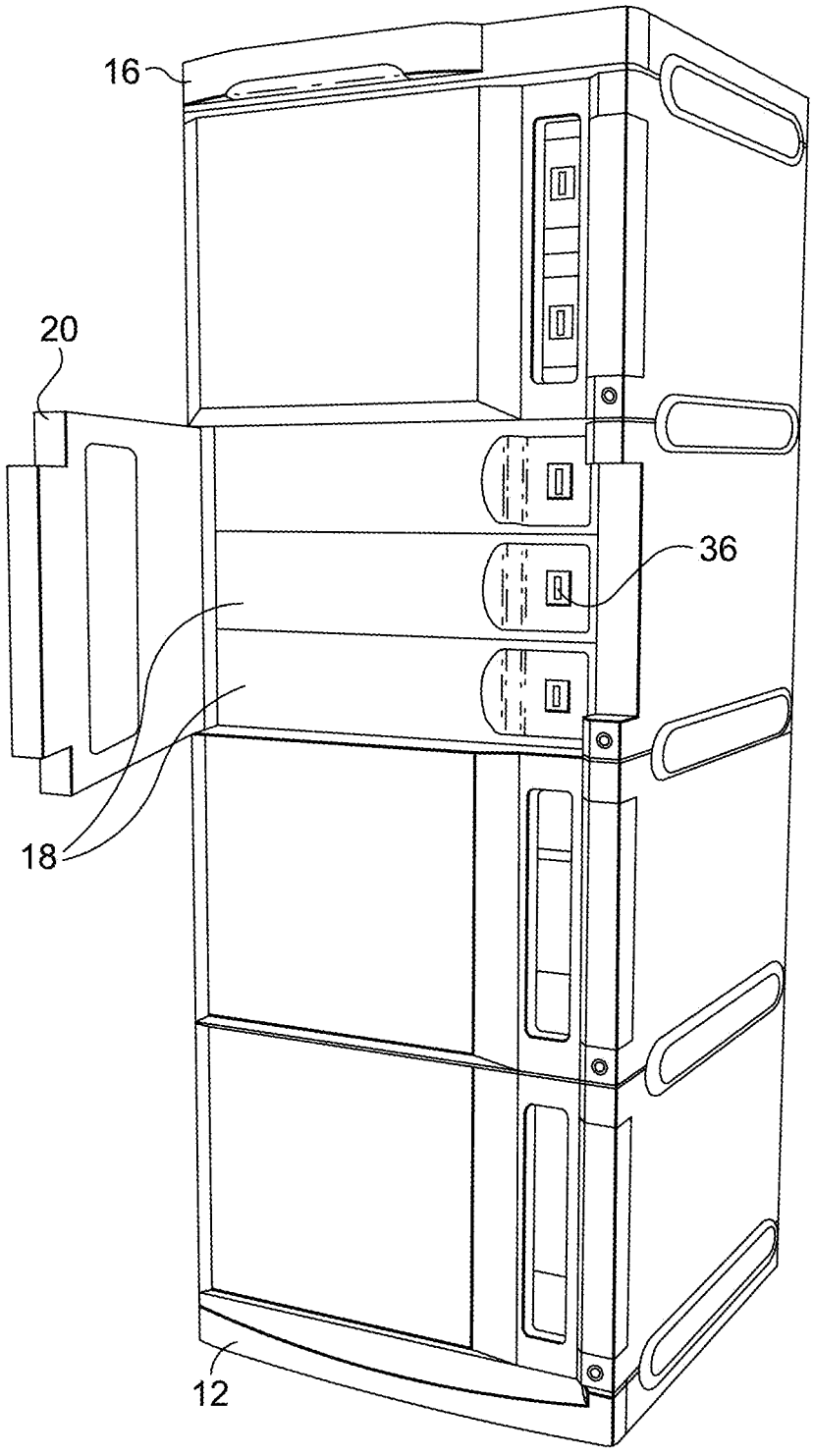


FIG. 2.

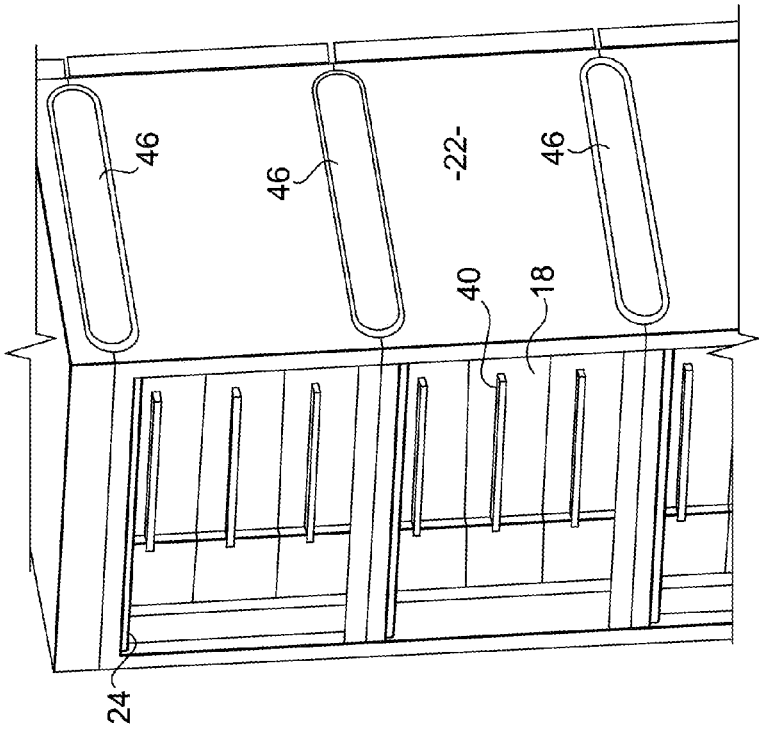


FIG. 4.

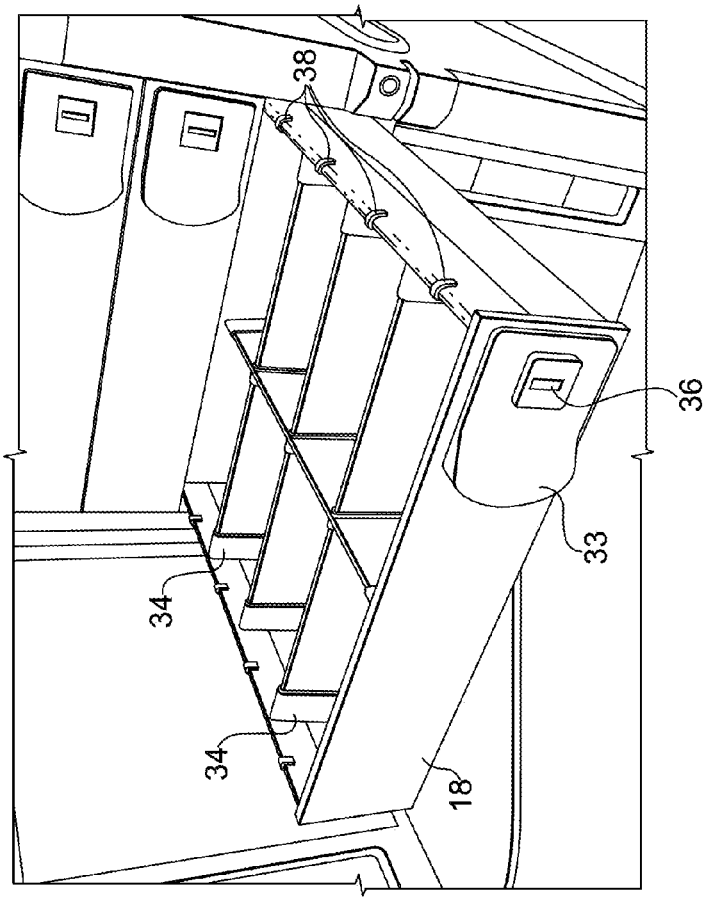
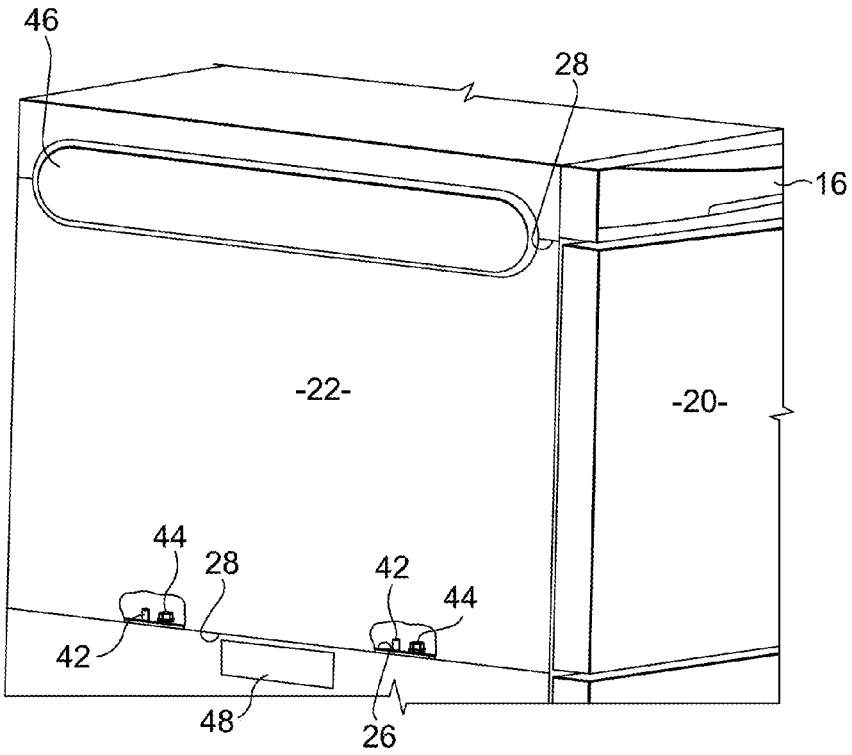


FIG. 3.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28
16
-22-
-20-
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FIG. 5.

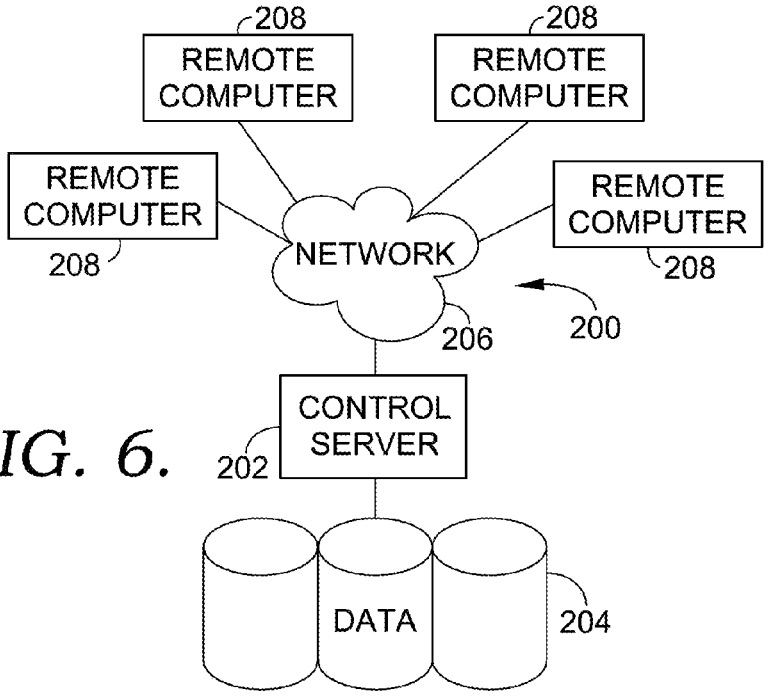
208
REMOTE COMPUTER
208
REMOTE COMPUTER
REMOTE COMPUTER
208
REMOTE COMPUTER
208
NETWORK
206
200
CONTROL SERVER
202
DATA
204

FIG. 6.

MEDICATION DISPENSING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of and claims the benefit of U.S. application Ser. No. 12/036,876, filed Feb. 25, 2008, entitled "Medication Dispensing Apparatus," which is entirely incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

BACKGROUND

As reported by the Institute of Medicine, an estimated 106,000 deaths occurred in 1994 due to adverse drug reactions (ADRs), and more than 2,000,000 hospitalized patients experienced serious, if not fatal, ADRs. Lazarou J. et al., *Incidence of adverse drug reactions in hospitalized patients: a meta-analysis of prospective studies*, J. Am. Med. Assn. 1998: 279: 1200-1205. Many of these errors are attributable to the systems and methods used to store and deliver medications to those clinicians providing care to patients. Various solutions have been proposed to address the issue of medication delivery errors. For instance, computerized systems ensure that the medication ordered or prescribed by the clinician is clinically appropriate. These systems may verify that the dosage is proper based on patient information such as weight and evidence based guidelines or protocols. Also, these systems may perform interaction checking against other medications. However, even if the clinician orders an acceptable medication and dosage amount for a specific patient, the actual drug and/or dosage administered to the patient may vary from what was requested. A pharmacist or other clinician may accidentally provide an improper drug or drug dosage if the order is not properly communicated and followed at each step in the clinical process. Errors may also occur during the steps of the medication administration process occurring between the pharmacy and the point of care. Existing systems and methods for physically transferring and storing and electronically tracking medications and supplied have been employed include automated dispensing machines (ADMs). To administer a medication to a patient, a nurse or other clinician retrieves the appropriate medication from one of a number of ADMs located throughout the healthcare facility. In addition to failing to prevent medication errors, existing systems and methods employing ADMs are wasteful and oftentimes difficult to use. The same issues apply when dispensing supplies.

SUMMARY

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

Embodiments of the present invention are directed to an automated medication dispenser. A medication dispenser provides automation to the steps of locating and acquiring medications or supplies to be administered to a patient or used during patient care. The medication dispenser includes one or more modules housing one or more compartmentalized drawers. Access to each drawer is controlled by a lockable door, and each drawer may only be slid from the module housing the drawer in response to a signal. A series of lights direct the user to the appropriate drawer and the appropriate compartment of the relevant drawer to remove the appropriate medication or supply.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

In the accompanying drawings, which form a part of the specification and are to be read in conjunction therewith and in which like reference numerals are employed to indicate like parts in the various views:

FIG. **1** is a front perspective view of a medication dispenser in accordance with an embodiment of the present invention;

FIG. **2** is a front perspective view of a medication dispenser in accordance with an embodiment of the present invention having a front door opened to provide access to the drawers;

FIG. **3** is a front perspective view of a medication dispenser in accordance with an embodiment of the present invention having a front door opened and one drawer in an open position;

FIG. **4** is a rear perspective view of a medication dispenser in accordance with an embodiment of the present invention with sections removed to demonstrate the construction and assembly of the modules of the medication dispenser;

FIG. **5** is a side perspective view of a medication dispenser in accordance with an embodiment of the present invention with sections removed to demonstrate the assembly of the modules of the medication dispenser; and

FIG. **6** is a block diagram of an exemplary medication information computing environment suitable for use in implementing the present invention.

DETAILED DESCRIPTION

With reference to the drawings, wherein like reference characters designate like parts throughout the different views, a medication and supply dispenser according to an embodiment of the present invention is designated generally with the reference numeral **10**. The medication dispenser **10** generally includes a footer plate **12**, a number of modules **14** and a header plate **16**, as depicted in FIGS. **1-5**. The modules **14** are disposed in a vertical stack, and each module contains a number of compartmentalized drawers **18** for storing and dispensing medical items which may include, for instance, medications in syringes, ampules, vials, oral suspensions, tubes, jars, oral solids and other packaging options, as well as a variety of medical supplies and other materials used in the provision of healthcare.

Each module **14** provides a controlled environment in which medications are stored. Each module **14** includes a front door **20** (that may be locked to regulate access to the drawers **18**), side walls **22**, a rear wall **24**, a top **26**, and a bottom **28**. In some embodiments, a refrigeration unit (not shown) may be coupled with one or more of the modules **14**, which may be desirable to avoid spoilage of certain types of medication.

Each front door **20** is lockable to limit access to only authorized clinicians. The door is hinged to one of the sidewalls **22** to rotate between a closed position as shown in FIG. **1** and an open position in FIG. **2**. As shown in FIG. **1**, each front door includes an opening **30** within which a window **32** is fixed. The window is transparent and allows a user to view a portion of each drawer as set forth in detail below.

When the front door is open, access is provided to the drawers **18**. Each drawer **18** may be slid from the module associated with the drawer when the front door **20** is open and the lock (not shown) for the particular drawer is unlocked. Specifically, when unlocked, a handle **33** of the drawer **18** may be grasped by the user to slide the drawer to an open position to allow access to a number of compartments **34** defined with the drawer **18**. The medications, supplies and other materials are stored within the compartments. Also, as described in operation below, each drawer includes a signal light **36**, and a number of selection lights **38** associated with each compartment **34**. In embodiments, the signal lights **36** and selection lights **38** are electronically coupled with a master circuit board and a power source (not shown) disposed in the header plate **16**. As shown in FIG. **4**, energy chains **40** are employed to house the cabling connecting the signal lights **36** and selection lights **38** in the drawers, and move along horizontally along with the drawers **18** when the drawers are opened and closed.

The modules **14** are configured to store multiple sized drawers **18** for medication storage and dispensing. For instance, referring to FIG. **1**, a single large drawer may be associated with a module for storing particularly large items and equipment. Two drawers of equal or differing sizes may be associated with a particular module. Also, as illustrated in FIG. **2**, three equally sized drawers may be housed within a module. It should be noted that drawer configurations different than those shown in FIGS. **1-5** may be employed in various embodiments of the invention (e.g., different drawer sizes, different number of drawers, different compartment configurations, etc.).

In an embodiment of the invention, as shown in FIG. **1**, four modules **14** are stacked between the footer plate **12** and the header plate **16**. With reference to FIG. **5**, each module **14** includes a placement handle **48**. The modules **14** are aligned to one another by a series of locating pins **42** extending from the top **26** of the lower module, and received within the bottom **28** of the upper module. Once located, a series of bolts **44** secure the modules one to another. The lowest module and the footer plate, and the uppermost module and the header plate, may be secured to one another in a similar manner. A series of cover strips **46** are secured on the exterior of the sidewalls **22** where each module is connected to another module, the header plate or the footer plate. In embodiments, the cover strips **46** are made of plastic, and overlay the seams to provide a unitary look to the device **10**. Any number of modules **14** may be employed from a single module to a stack of four or more modules. The design allows a common construction for high volume areas of a hospital requiring a stack of multiple modules and lower volume areas of a health care provider in which a single module may effectively serve the population of recipients of care.

Referring again to FIG. **3**, to stock the medication dispenser **10**, medical items such as, for example, medications are initially placed into compartments **34**. When medical items are placed into each compartment **34**, the medical items and compartments **34** are identified to a computer system, which associates the medical items with their corresponding compartments **34**. For instance, a compartment **34** may be identified to the computer system by reading a bar code located on, or associated with, the compartment **34** or by manually entering a compartment identifier. Similarly, in some embodiments, each medication or supply may be provided in a package having an identification marking, such as a bar code, an RFID tag, or some other identifier. A medical item may then be identified to the computer system by reading the bar code or RFID tag located on the medication package or by manually entering an identifier associated with the medical item.

After medications or supplies have been placed into compartments **34**, the drawers **18** are slid into the closed position, and locked into place by locks (not shown) in electrical connection with the master circuit board and a power source (not shown) disposed in the header plate **16**. The front doors **20** are also closed and locked.

When a medication or supply is to be dispensed from the medication dispenser **10**, a medication or supply is initially selected, for instance, by a clinician interacting with a computer system associated with the medication dispenser **20**. The computer system accesses information associating medications or supplies with the location of the medication or supply. Specifically, the computer system determines the location of the module **14**, drawer **18** and compartment **34** within which the relevant item is located. Next, the computer system communicates to the processor located in the header plate **16**. The processor sends a signal to illuminate the signal light **26** of the appropriate drawer from which an item is to be retrieved. The user can visually identify the signal light **26** through the window **32**. Also, in response to the signal, the front door **20** of the module within which the desired medication or supply is located is unlocked. The lock to the appropriate drawer **18** is unlocked, too, and drawer **18** with the illuminated signal light **26** is pulled open to the position as shown in FIG. **3**. The processor also sends a signal to illuminate the appropriate selection light **38** to direct to the user to the appropriate compartment **34** in the appropriate drawer **18**. In an embodiment, the process is repeated until each of the relevant medications and supplies are removed from the device **10**. In some embodiments, multiple selection lights and signal lights may be illuminated simultaneously to allow the user to remove multiple items. In embodiments, the user may provide feedback to the computer system to verify that a specific medication or supply has been removed from the device.

As indicated previously, a computer system is provided for controlling the operation of the medication dispenser **10**. In some embodiments, the computer system includes a computing device dedicated to the medication dispenser **10**. The medication dispenser computing device may receive inputs, such as inputs associated with loading and medication-dispensing operations. Based on the inputs, the medication dispenser computing device controls the processor of device **10** and thus the locks, signal lights and selection lights of the present invention.

In some embodiments, the medication dispenser computing device may act as a stand-alone device such that the medication dispenser computing device maintains all data necessary for operating the medication dispensing operations of the medication dispenser **10**. In other embodiments, however, the medication dispenser computing device operates within a distributed clinical computing environment. In particular, the medication dispenser computing device may be interfaced with or integrated into a medical information computer system. The medical information computing system may be a comprehensive computing system within a clinical environment such as the exemplary medical information computing system environment **200** shown in FIG. **20**. It will be understood and appreciated by those of ordinary skill in the art that the illustrated medical information computing system environment **200** is merely an example of one suitable computing environment and is not intended to suggest any limitation as to the scope of use or functionality of the invention. Neither should the medical information computing system

environment **202** be interpreted as having any dependency or requirement relating to any single component or combination of components illustrated therein.

Embodiments of the present invention may be operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well-known computing systems, environments, and/or configurations that may be suitable for use with the present invention include, by way of example only, personal computers, server computers, hand-held or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above-mentioned systems or devices, and the like.

Embodiments of the present invention may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include, but are not limited to, routines, programs, objects, components, and data structures that perform particular tasks or implement particular abstract data types. Embodiments of the present invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in local and/or remote computer storage media including, by way of example only, memory storage devices.

With continued reference to FIG. **6**, the exemplary medical information computing system environment **200** includes a general purpose computing device in the form of a server **202**. Components of the server **202** may include, without limitation, a processing unit, internal system memory, and a suitable system bus for coupling various system components, including database cluster **204**, with the server **202**. The system bus may be any of several types of bus structures, including a memory bus or memory controller, a peripheral bus, and a local bus, using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronic Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus, also known as Mezzanine bus.

The server **202** typically includes, or has access to, a variety of computer readable media, for instance, database cluster **204**. Computer readable media can be any available media that may be accessed by server **202**, and includes volatile and nonvolatile media, as well as removable and non-removable media. By way of example, and not limitation, computer readable media may include computer storage media and communication media. Computer storage media may include, without limitation, volatile and nonvolatile media, as well as removable and nonremovable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, program modules, or other data. In this regard, computer storage media may include, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVDs) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage, or other magnetic storage device, or any other medium which can be used to store the desired information and which may be accessed by the server **202**. Communication media typically embodies computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and may include any information delivery media. As used herein, the term "modulated data signal" refers to a signal that has one or more of its attributes set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared, and other wireless media. Combinations of any of the above also may be included within the scope of computer readable media.

The computer storage media discussed above and illustrated in FIG. **1**, including database cluster **204**, provide storage of computer readable instructions, data structures, program modules, and other data for the server **202**.

The server **202** may operate in a computer network **206** using logical connections to one or more remote computers **208**. Remote computers **208** may be located at a variety of locations in a medical or research environment, for example, but not limited to, clinical laboratories, hospitals and other inpatient settings, veterinary environments, ambulatory settings, medical billing and financial offices, hospital administration settings, home health care environments, and clinicians' offices. Clinicians may include, but are not limited to, a treating physician or physicians, specialists such as surgeons, radiologists, cardiologists, and oncologists, emergency medical technicians, physicians' assistants, nurse practitioners, nurses, nurses' aides, pharmacists, dieticians, microbiologists, laboratory experts, genetic counselors, researchers, veterinarians, students, and the like. The remote computers **208** may also be physically located in non-traditional medical care environments so that the entire health care community may be capable of integration on the network. The remote computers **208** may be personal computers, servers, routers, network PCs, peer devices, other common network nodes, or the like, and may include some or all of the components described above in relation to the server **202**. The devices can be personal digital assistants or other like devices.

Exemplary computer networks **206** may include, without limitation, local area networks (LANs) and/or wide area networks (WANs). Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets, and the Internet. When utilized in a WAN networking environment, the server **202** may include a modem or other means for establishing communications over the WAN, such as the Internet. In a networked environment, program modules or portions thereof may be stored in the server **202**, in the database cluster **24**, or on any of the remote computers **208**. For example, and not by way of limitation, various application programs may reside on the memory associated with any one or more of the remote computers **208**. It will be appreciated by those of ordinary skill in the art that the network connections shown are exemplary and other means of establishing a communications link between the computers (e.g., server **202** and remote computers **208**) may be utilized.

In operation, a user may enter commands and information into the server **202** or convey the commands and information to the server **202** via one or more of the remote computers **208** through input devices, such as a keyboard, a pointing device (commonly referred to as a mouse), a trackball, or a touch pad. Other input devices may include, without limitation, microphones, satellite dishes, scanners, or the like. Commands and information may also be sent directly from a remote healthcare device to the server **202**. In addition to a monitor, the server **202** and/or remote computers **208** may include other peripheral output devices, such as speakers and a printer.

Although many other internal components of the server **202** and the remote computers **208** are not shown, those of

ordinary skill in the art will appreciate that such components and their interconnections are well known. Accordingly, additional details concerning the internal construction of the server **202** and the remote computers **208** are not further disclosed herein.

By interfacing and/or integrating a medication dispensing computing device with a comprehensive medical information computing system, such as the medical information computing system **200** of FIG. **6**, a number of advantages may be realized. For example, the medication dispensing clinical device may be interfaced with or otherwise access computing devices and/or computing systems in a variety of different clinical domains within a healthcare environment. By way of example only and not limitation, the medical information computing system **200** may include a clinical laboratory system, a pharmacy system, a radiology system, and a hospital administration system. Accordingly, the medical information computing system **200** provides a unified computing architecture that is able to access and aggregate clinical information from a variety of different clinical domains and make the clinical information available to the medication dispensing computing device. In an embodiment, the medical information computing system **200** may store clinical information from different clinical domains in a patient-centric electronic medical record (including an electronic medication administration record) accessible to multiple devices within the system **200**, including the medication dispensing computing device. Accordingly, medication dispensing may be automated and clinician workflow may be supported from medication prescribing through medication dispensing and administration. As such, a closed process may be provided that delivers increased patient safety throughout the medication process, greater speed in the medication dispensing process, and improved efficiency for clinicians.

The present invention has been described in relation to particular embodiments, which are intended in all respects to be illustrative rather than restrictive. Alternative embodiments will become apparent to those of ordinary skill in the art to which the present invention pertains without departing from its scope. Substitutions may be made and equivalents employed herein without departing from the scope of the invention as recited in the claims. It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated and within the scope of the claims.

What is claimed is:

1. A stackable module that houses and dispenses medical items, wherein the medical items comprise one or more of medications or medical supplies, the stackable module being coupled to a computing device that controls operation of the stackable module, the stackable module comprising:

an environment for storing the medical items, the environment being defined by a top, a bottom, a rear wall, two side walls, and a lockable door hingedly connected to one of the two side walls, the lockable door having a transparent window disposed therein;

one or more locating pins extending from the top of the stackable module, wherein the one or more locating pins can be received within an adjacent bottom of a second stackable module to facilitate stacking the second stackable module vertically adjacent to the stackable module;

at least one drawer disposed within the environment for storing the medical items, the at least one drawer associated with a signal light, the signal light visually aligned with the transparent window of the lockable door when the lockable door is in a closed door position; and

at least one compartment defined within the at least one drawer, the at least one compartment for storing at least one of the medical items.

2. The stackable module of claim **1**, wherein the signal light is attached to a front side of the at least one drawer so that the signal light is visible through the transparent window when the lockable door is in the closed door position.

3. The stackable module of claim **1**, further comprising a selection light associated with the at least one compartment.

4. The stackable module of claim **1**, wherein a plurality of drawers of differing sizes is disposed within the stackable module.

5. The stackable module of claim **4**, wherein each of the plurality of drawers is lockable.

6. The stackable module of claim **5**, wherein the computing device controls access to each of the plurality of drawers.

7. A system that dispenses medical items, wherein the medical items comprise one or more of medications or medical supplies, the system comprising:

a footer plate;

a plurality of stackable modules disposed in a vertical stack on top of the footer plate, each of the plurality of stackable modules comprising an environment for storing the medical items, the environment being defined by a top, a bottom, a rear wall, two side walls, and a lockable door coupled to one of the two side walls, wherein the lockable door is moveable between a closed door position and an open door position, and wherein the lockable door has a transparent window disposed therein;

at least one lockable drawer disposed within each stackable module, the at least one lockable drawer associated with a signal light, the signal light visible through the transparent window of the lockable door when the lockable door is in the closed door position; and

a computing device communicatively coupled to the plurality of stackable modules, wherein the computing device controls access to the medical items stored in each of the plurality of stackable modules.

8. The system of claim **7** wherein the lockable door is hinged to the one of the two side walls, and wherein the signal light is attached to a front side of the at least one lockable drawer so that the signal light is visible through the transparent window when the lockable door is in the closed door position.

9. The system of claim **7**, further comprising a header plate disposed on top of the vertical stack of the plurality of stackable modules.

10. The system of claim **9**, further comprising a selection light associated with at least one compartment disposed within the at least one lockable drawer.

11. The system of claim **10**, further comprising a master circuit board and a power source disposed in the header plate, wherein the signal light and the selection light are electronically coupled with the master circuit board and the power source using cabling.

12. The system of claim **11**, further comprising energy chains that house the cabling, wherein the energy chains move along with the at least one lockable drawer as the at least one lockable drawer is moved between an open drawer position and a closed drawer position.

13. A system that dispenses medical items, wherein the medical items comprise one or more of medications or medical supplies, the system comprising:

a footer plate;

a plurality of stackable modules disposed in a vertical stack on top of the footer plate, each of the plurality of stackable modules comprising an environment for storing the

medical items, the environment being defined by a top, a bottom, a rear wall, two side walls, and a lockable door hingedly coupled to one of the two side walls, the lockable door having a transparent window disposed therein, wherein a first one of the plurality of stackable modules is aligned to a second one of the plurality of stackable modules by a series of locating pins extending from the top of the first one of the plurality of stackable modules and being received within the bottom of the second one of the plurality of stackable modules;

a header plate disposed on top of the vertical stack of the plurality of stackable modules;

a master circuit board and a power source disposed in the header plate;

at least one lockable drawer disposed within each stackable module, wherein the at least one lockable drawer is associated with a signal light, the signal light visible through the transparent window of the lockable door when the lockable door is in a closed door position, and wherein the at least one lockable drawer comprises at least one compartment defined therein for storing at least one of the medical items; and

a computing device communicatively coupled to the plurality of stackable modules, wherein the computing device controls access to the medical items stored in each of the plurality of stackable modules.

14. The system of claim **13**, wherein the signal light is attached to a front side of the at least one lockable drawer so that the signal light is visible through the transparent window when the lockable door is in the closed door position.

15. The system of claim **14**, further comprising a selection light associated with the at least one compartment.

16. The system of claim **15**, wherein the signal light and the selection light are electronically coupled with the master circuit board and the power source using cabling.

17. The system of claim **16**, further comprising energy chains that house the cabling, wherein the energy chains move along with the at least one lockable drawer as the at least one lockable drawer is moved between an open drawer position and a closed drawer position.

18. The system of claim **13**, wherein the at least one lockable drawer comprises a plurality of drawers of differing sizes, wherein each of the plurality of drawers is lockable, and wherein the computing device controls access to each of the plurality of drawers.

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